Deferred retirement curbs business profits?

An analysis of firm performance and labor flows by age group with linked employer-employee data*

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As a response to the aging of citizens, governments are trying to encourage aging workers to stay longer at work. These aims are costly to the employers if Lazear's deferred payment hypothesis holds. According to the theory, separations of older workers should be beneficial to firms. By using comprehensive linked employer-employee data from the Finnish business sector, we study the productivity and wage effects, and hence the profitability effects, of hiring and separation of younger and older workers. Unlike other labor flows, separations of older workers have a strong positive impact on profitability. Robustness checks include the use of regional labor supply and other variables as instruments for the potential endogeneity of labor flows.

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1. Introduction

Increasing average age of the work force poses difficult challenges both to firms and the whole society. As a result of changes in the age structure, an increasing share of firms' employees is in higher age groups. On the other hand, pressures on the sustainability of pension systems have led governments to find ways of getting people lengthen their working lives. There have been efforts to improve incentives to reduce the use of early retirement channels, as the actual retirement age in many countries falls clearly below the mandatory retirement age (OECD, 2006). There have also been demands for raising the mandatory retirement age, but also for extending the subjective right to continue working. Most notably, in the US mandatory retirement age rules have been eliminated in most private sector jobs as a result of anti-age-discrimination laws introduced in the 1960s. There have been policy changes also in some European countries. Either the subjective right has been extended (for example in Finland to 68 years) or workers have the right to request to stay on the job after the mandatory retirement age (for example in the UK). These developments will in turn still increase the average age of the work force.

From the firms' point of view, an important issue is how to deal with the aging work force. To illustrate the firms' dilemmas, we can consider the following examples. The Swedish high-tech firm Ericsson recently (April 2006) decided to offer redundancy to workers in the 35 to 50 age group and having at least 6 years' seniority. This was based on the firm's view that staff turnover was too low and the age structure was becoming disadvantageous to the firm. A confidential Wal-Mart memorandum leaked to the media in 2005 stated that aging workforce and increasing tenure caused an unacceptable growth in benefit costs.[1] On the other hand, there are examples where firms have been able to prosper by keeping or hiring older workers or have experienced disruption of productivity when older employees with tacit knowledge have left. The role of aging employees to the firm's performance may be an industry-specific issue.

It is not immediately clear, what is an optimal age structure or optimal turnover rate for a firm. Young workers are less experienced, but usually have longer and more up-to-date

education. Older workers may have passed the peak of their physical productivity, but may be able to compensate for it with their long experience. The decision on the age structure also depends on labor supply. The availability of workers of different ages may rapidly change, since the younger age cohorts are smaller than the old ones. This may encourage firms to keep their aging employees. The wage structure also has an impact on the firms' choices, since it is the productivity and wage effects together that determine the impact of the age structure on firm performance. Wages often have seniority-based elements, either because of wage growth with accumulation of human capital through experience, or because of deferred payments elements in wage setting. According to the deferred payments argument (Lazear, 1979), lower pay of the employees in their early career is repaid by the firm in the form of wage that exceeds productivity in the later career. If pension is partly based on the income during the last years in work, there is an additional incentive for employees to bargain for a back-loaded wage. While Lazear uses this feature of wage determination to explain the existence of mandatory retirement, it can also give an explanation for differences between age groups in the employers' incentives to initiate separations.

Our paper relates the discussion of retirement incentives to two fields of literature. One is the connection of age and productivity, which has been extensively discussed in psychology and physiology (e.g. Kanazawa, 2003), and in recent years also in economics. Since individual-level productivity measures are available only in very special cases, a field of research has emerged, where linked employer-employee data sets are used for analyzing the impact of work force characteristics, like average age, on plant- or firm-level productivity and wage (e.g. Hellerstein, Neumark, & Troske, 1999; Hellerstein & Neumark, 2004; Ilmakunnas & Maliranta, 2005; Maliranta & Ilmakunnas, 2005; Daveri & Maliranta, 2006). A drawback of this line of studies is that they do not pay much attention to how the structure of the work force is determined, although in some studies the work force age (and other characteristics) have been instrumented (Aubert & Crépon, 2003; Malmberg, Lindahl, & Halvarsson, 2005; Daveri & Maliranta, 2006).

These studies with linked data sets are mostly concerned with comparisons of productivity and wage profiles to test different theories of wage formation. The results in this literature are not quite conclusive, but there is some evidence from various countries that firm productivity tends to have an inverted U-shaped relationship with age, while average wage is increasing in age (for a survey, see Skirbekk, 2003). Evaluation of the performance of firms has not been a central issue in this context. We will also utilize linked data, but will extend the analysis to directly examining how the age structure of the work force changes through the inflow and outflow of labor input and how the flows subsequently influence firm profitability.

Another strand of research that our paper is related to is the connection between labor turnover and firm performance. Much of this work has appeared in the field of human resource management, where the analysis is often restricted to special data sets with emphasis on quit behavior and the firms' policies to control it. Traditionally, the negative aspects of this kind of turnover have been emphasized. In the parlance of the management literature (e.g. Dalton, Todor, & Krackhardt, 1982), separation is dysfunctional, when those high-productivity workers whom the organization would like to keep, are leaving. This involves costs in the form of hiring and retraining, but also less indirectly in the form of disruption of informal communication structures. Costs may be caused also by employer-initiated separations in the form of firing costs. Also the traditional labor economics view is that turnover is costly activity that needs to be controlled for example with wage policy since otherwise the employees would not stay long enough to accumulate specific human capital. There are also models for optimizing hiring and separation to maximize profits (e.g. Hamermesh & Pfann, 1996). In these models it is assumed that both hiring and firing have negative consequences through adjustment costs.

In contrast to the traditional view, from the 1980's management research has emphasized that labor turnover can also be functional, i.e. in the interest of the organization. This can happen e.g. when low productivity workers quit or their separation from the firm is initiated by the employer. Replacing the leavers by new workers also brings new ideas

and knowledge to the firm. In economics, the positive influences of turnover have been emphasized more formally in models where the search and matching process allocates workers to their best uses in firms (e.g. Jovanovic, 1979).

The existing empirical evidence on the effect of various measures of labor turnover on firm performance (measured by productivity or profitability) is somewhat mixed. A drawback in this field of work is that most of the research is concerned with separations (and often only with quits) and the hiring side of turnover has received much less attention, except indirectly, since separations lead to a need for rehiring. There are, however, a few studies that have examined the separate effects of hiring and separation on performance; Bingley and Westergaard-Nielsen (2004) and Ilmakunnas et al. (2005) using firm or plant data, and Blakemore and Hoffman (1989) with aggregate data. Further, there is hardly any work that studies the impacts of turnover of different types of employees. If there is a connection between e.g. the age structure of the work force and performance, it is the inflow and outflow of different types of employees that the firms should control to optimize the work force structure. If all employees were perfect substitutes, worker turnover would be dysfunctional since it would just cause costs without having a positive impact on productivity.[2] The only necessary turnover would be such that is needed for expanding or reducing the total size of the labor input.

In practice, however, the age structure of the employees changes when the average age level of the inflow differs from that of the outflow. The optimal age mix of employees, and therefore the optimal inflow and outflow of different age groups, is based on the relative productivities and wages of the age groups. The choice is constrained by legal limits on layoffs, availability of different types of employees (i.e., local labor supply), and differences in the quit propensities of different employee types.

Our approach is to disaggregate labor flows to and from firms by age to three groups, "young" (30 or less), "middle-aged" (31 to 50), and "old" (over 50). (We emphasize that the labels "young" and "old" are used just for illustrative purposes and refer to relative age.) We show that firm-level labor productivity change can be decomposed to the effects

of the hiring and separation flows of the age groups and to the effect of productivity growth of those staying in the firm. Our decomposition bears a resemblance to the kind of decompositions used frequently to decompose industry-level productivity change to the impacts of entry and exit of firms, and productivity growth in continuing firms as used by Foster et al. (2001) and more closely to the formulas proposed by Maliranta (1997), and more recently by Diewert and Fox (2005). In contrast to the industry studies where firm productivities are observed, in our case the productivity of the individual employees within firms cannot be measured. However, the decomposition leads to a simple estimation equation where the parameters have the interpretation of relative productivity levels of the different employee groups. A similar decomposition can be made for firm wage growth. Combining the two decompositions, we also obtain an equation for firm profitability change, which is our main interest. To be able to perform the analysis we need detailed and comprehensive employer-employee data. We use the FLEED (Finnish Longitudinal Employer-Employee Data) of Statistics Finland that covers basically all firms in the country and all of their employees. The decompositions relate to performance change in the two-year intervals 1995-97, 1997-99, 1999-2001, and 2001-2003.

Our results show that there are indeed differences between the age groups in their relative productivity and wage levels, and hence the age structure may have impacts on firm performance. In particular, we find that the outflow of older workers has an economically strong positive effect on the firm's profitability. This is mainly because of the productivity level of older workers (before separation) is substantially below that of the average worker in the firm but their wage level is, however, reasonably close to the average. Other labor flows instead have quite neutral effects on the firm's profits. On the hiring side for instance, the relative wage levels of older workers correspond to the relative productivity levels so that the inflow of older workers does not change the profitability of the firm. Separated young workers have considerably higher productivity levels than the average worker or separated older workers. But the wage levels of the separated young workers are also relatively high, which means that outflow of young workers does not harm the firm's profitability significantly. To control for the fact that the labor flows are to a large extent chosen by the firm, we instrument the flows by

variables that describe either exogenous changes in the supply in the local labor market (to instrument hiring), and changes in local labor demand or the characteristics of the existing work force of the firms (to instrument separation). The instrumental variable estimation results provide further support to our main finding that separations of older workers have been profitability-enhancing.

The structure of the paper is as follows. In section 2 we describe the decomposition of the growth in productivity, wage, and profitability to the impacts of the labor flows. In section 3 we describe the data set and present the estimation results. Section 4 concludes the paper with some suggestions for further research.

2. Decomposition of firm performance

We assume that a firm's labor force consists of M different age groups (cohorts) $j = 1, \ldots, M$, and that the firm's output (value added) in period 1 can be defined as the sum of outputs of all the worker groups:

$$Y_1 = \sum_j^M Y_{1j} \,. \tag{1}$$

The firm's labor productivity is the average of labor productivities, weighted by labor shares:

$$\frac{Y_1}{L_1} = \sum_j^M \frac{L_{1j}}{L_1} \frac{Y_{1j}}{L_{1j}}. \tag{2}$$

where $L_1 = \sum_j^M L_{1j}$. Each worker age group can be divided into two subgroups; workers who worked in the previous period 0 and are still working in the firm, i.e., stayers (*stay*), and those who are working in the firm in year 1 but were not there in period 0, i.e., they were hired after 0 (*hire*). The firm's labor productivity level can then be expressed as follows:

$$\frac{Y_1}{L_1} = \sum_j^M \frac{L_{1j,stay}}{L_1} \frac{Y_{1j,stay}}{L_{1j,stay}} + \sum_j^M \frac{L_{1j,hire}}{L_1} \frac{Y_{1j,hire}}{L_{1j,hire}} \tag{3}$$

Because

$$\sum_{j}^{M}\frac{L_{1j,stay}}{L_1}+\sum_{j}^{M}\frac{L_{1j,hire}}{L_1}=1$$

(3) can be written as follows:

$$\begin{aligned}\frac{Y_1}{L_1}&=\sum_{j}^{M}\frac{L_{1j,stay}}{\sum_{1j}L_{1j,stay}}\frac{Y_{1j,stay}}{L_{1j,stay}}+\sum_{j}^{M}\frac{L_{1j,hire}}{L_1}\left(\frac{Y_{1j,hire}}{L_{1j,hire}}-\sum_{j}^{M}\frac{L_{1j,stay}}{\sum_{1j}L_{1j,stay}}\frac{Y_{1j,stay}}{L_{1j,stay}}\right)\\&=\sum_{j}^{M}\frac{L_{1j,stay}}{\sum_{1j}L_{1j,stay}}\frac{Y_{1j,stay}}{L_{1j,stay}}+\sum_{j}^{M}\frac{L_{1j,hire}}{L_1}\left(\frac{Y_{1j,hire}}{L_{1j,hire}}-\frac{Y_{1,stay}}{L_{1,stay}}\right)\end{aligned}\tag{4}$$

To write the labor productivity level of the firm in period 0 we define a third subgroup, those who were in the firm in period 0, but are no longer there in 1, i.e. those who have separated after 0 (*sepa*). We can write the period 0 productivity in an analogous way to (4):

$$\begin{aligned}\frac{Y_0}{L_0}&=\sum_{j}^{M}\frac{L_{0j,stay}}{\sum_{0j}L_{0j,stay}}\frac{Y_{0j,stay}}{L_{0j,stay}}+\sum_{j}^{M}\frac{L_{0j,sepa}}{L_0}\left(\frac{Y_{0j,sepa}}{L_{0j,sepa}}-\sum_{j}^{M}\frac{L_{0j,stay}}{\sum_{0j}L_{0j,stay}}\frac{Y_{0j,stay}}{L_{0j,stay}}\right)\\&=\sum_{j}^{M}\frac{L_{0j,stay}}{\sum_{0j}L_{0j,stay}}\frac{Y_{0j,stay}}{L_{0j,stay}}+\sum_{j}^{M}\frac{L_{0j,sepa}}{L_0}\left(\frac{Y_{0j,sepa}}{L_{0j,sepa}}-\frac{Y_{0j,stay}}{L_{0j,stay}}\right)\end{aligned}\tag{5}$$

Of course it holds that

$$\sum_{j}^{M}L_{0j,stay}=\sum_{j}^{M}L_{1j,stay}\ .$$

We are interested in labor productivity growth, i.e., difference in productivity level between periods 0 and 1, i.e.

$$\Delta\frac{Y}{L}=\frac{Y_1}{L_1}-\frac{Y_0}{L_0}.\tag{6}$$

We define the worker groups in such a way that none of the staying workers changes his or her age group between periods 0 and 1, i.e.,

$L_{0j,stay}=L_{1j,stay}$ (and $\frac{L_{0j,stay}}{\sum_{0j}L_{1j,stay}}=\frac{L_{1j,stay}}{\sum_{1j}L_{1j,stay}}$) for all j. Note that people are, of course, aging over time, but the age groups should be understood as cohorts rather than absolute age groups.

We then obtain

$$\frac{Y_1}{L_1}-\frac{Y_0}{L_0}= \\ \sum_j^M \frac{L_{0j,stay}}{\sum_{0j} L_{1j,stay}}\left(\frac{Y_{1j,stay}}{L_{1j,stay}}-\frac{Y_{0j,stay}}{L_{0j,stay}}\right)+ \\ \sum_j^M \frac{L_{1j,hire}}{L_1}\left(\frac{Y_{1j,hire}}{L_{1j,hire}}-\frac{Y_{1,stay}}{L_{1,stay}}\right)+ \\ \sum_j^M \frac{L_{0j,sepa}}{L_0}\left(\frac{Y_{0,stay}}{L_{0,stay}}-\frac{Y_{0j,sepa}}{L_{0j,sepa}}\right) \tag{7}$$

The first set of terms on the right-hand side of the equation shows the productivity growth "within workers", i.e. the productivity growth that accumulates over time for those who are staying in the firm. It can be interpreted as productivity growth due to accumulation of human capital through experience. The within worker productivity growth may vary across the age groups, and the total effect is a labor share weighted average of productivity changes in the different groups. A firm has a rapid productivity growth when a large proportion of workers have a high productivity growth. This may be due to adoption or innovation of more productive techniques, for example.

The second set of terms indicates productivity effects of hiring different age groups. As can be seen from (7), hiring of type *j* workers has a positive impact on productivity change when these hired workers have a higher productivity level than the average staying workers. Newly hired workers may be more productive than incumbents in period 1 because they have learned more productivity techniques when they worked for the previous employer, or have more recent education, for example. Adjustment costs related to the hiring of new employees are implicitly included in our formulation. The relative productivity of the hired workers is net of adjustment costs.

Finally, the third set of terms indicates productivity effects of separations of different worker age groups. Quite analogously to the hiring effect, separation of type *j* workers has a positive effect on productivity change when these workers have a lower productivity level than the average incumbent in period 0. Again, the productivity impact is net of adjustment costs.

The terms of (7) can be turned to growth rates by dividing the average productivity level in the periods 0 and 1. The growth rate is then a close approximation of a more common log-difference, i.e.,

$$\frac{Y_1/L_1 - Y_0/L_0}{0.5\left(Y_1/L_1 + Y_0/L_0\right)} \cong \ln\frac{Y_1/L_1}{Y_0/L_0} \tag{8}$$

Besides labor productivity, we can use a similar decomposition for the average wage level in the firm. In this case we just replace Y in the equations by the wage sum *W*.

The profitability of type *j* workers relative to staying workers is can be measured as follows:

$$\frac{1+\dfrac{OPM_j}{W_j\left(1+a\right)}}{1+\dfrac{OPM_{stay}}{W_{stay}\left(1+a\right)}} = \frac{\dfrac{Y_j}{W_j\left(1+a\right)}}{\dfrac{Y_{stay}}{W_{stay}\left(1+a\right)}} = \frac{\dfrac{Y_j/L_j}{\left(W_j/L_j\right)\left(1+a\right)}}{\dfrac{Y_{stay}/L_{stay}}{\left(W_{stay}/L_{stay}\right)\left(1+a\right)}}, \tag{9}$$

where *OPM* denotes operating margin (i.e., $OPM = Y - W(1+a)$) and *a* the ratio of payroll taxes to wages (assumed to be constant across different age groups). The profitability of age group *j* relative to all staying workers is obtained by

$$\ln\frac{Y_j}{W_j\left(1+a\right)} - \ln\frac{Y_{stay}}{W_{stay}\left(1+a\right)} = \ln\frac{Y_j/L_j}{Y_{stay}/L_{stay}} - \ln\frac{W_j/L_j}{W_{stay}/L_{stay}} \tag{10}$$

Equation (10) shows that the profitability gap between worker age groups (on the left-hand side of equation) is the difference between labor productivity gap and wage gap (on the right-hand side of equation).

Equation (7) can be used for estimating productivity gaps and wage gaps between age groups both in the hiring side and in the separation side.

On the basis of (7) and (8) we obtain the following estimation models:

$$\frac{\Delta\left(Y/L\right)}{\left(Y/L\right)} = \alpha + \sum_j^M \beta_{LP,j,hire} HR_j + \sum_j^M \beta_{LP,j,sepa} SR_j + \sum_j^{M-1} \chi_{LP,j,stay} STAYSH_j + \delta'\mathbf{Z} + \varepsilon \tag{11}$$

$$\frac{\Delta\left(W/L\right)}{\left(W/L\right)} = \alpha + \sum_j^M \beta_{W,j,hire} HR_j + \sum_j^M \beta_{W,j,sepa} SR_j + \sum_j^{M-1} \chi_{W,j,stay} STAYSH_j + \delta'\mathbf{Z} + \varepsilon \tag{12}$$

$$\frac{\Delta\Pi}{\overline{\Pi}} = \alpha + \sum_{j}^{M} \beta_{\Pi,j,hire} HR_j + \sum_{j}^{M} \beta_{\Pi,j,sepa} SR_j + \sum_{j}^{M-1} \chi_{\Pi,j,stay} STAYSH_j + \delta' \mathbf{Z} + \varepsilon \tag{13}$$

where $\overline{(Y/L)} = 0.5\left[(Y_0/L_0)+(Y_1/L_1)\right]$, $\overline{(W/L)} = 0.5\left[(W_0/L_0)+(W_1/L_1)\right]$,

$HR_j = \frac{L_{1j,hire}}{L_1}$, $SR_j = \frac{L_{0j,sepa}}{L_0}$, $STAYSH_j = \frac{L_{0j,stay}}{L_{0,stay}}\left(= \frac{L_{1j,stay}}{L_{1j,stay}}\right)$ and $\Pi = 1 + \frac{OPM}{W(1+a)}$. We have added control variables Z to account for other exogenous influences on firm productivity, wage, and profits. In the estimations, panel data will be used, so the equations to be estimated are indexed with *i* (firm) and *t* (period), which are not shown in (13)..

In the hiring side the coefficients of our main interest that will be estimated are

$$\beta_{(Y/L),j,hire} = \frac{(Y/L)_{1,j,hire} - (Y/L)_{1,stay}}{\overline{(Y/L)}} \tag{14}$$

$$\beta_{(W/L),j,hire} = \frac{(W/L)_{1,j,hire} - (W/L)_{1,stay}}{\overline{(W/L)}} \tag{15}$$

$$\beta_{\Pi,j,hire} = \frac{\Pi_{1,j,hire} - \Pi_{1,stay}}{\overline{\Pi}} \tag{16}$$

It follows from (10) that

$$\beta_{\Pi,j,hire} \approx \beta_{(Y/L),j,hire} - \beta_{(W/L),j,hire}$$

For the separation side, estimable coefficients are obtained analogously

$$\beta_{(Y/L),j,sepa} = \frac{(Y/L)_{0,stay} - (Y/L)_{0,j,sepa}}{\overline{(Y/L)}} \tag{17}$$

$$\beta_{(W/L),j,sepa} = \frac{(W/L)_{0,stay} - (W/L)_{0,j,sepa}}{\overline{(W/L)}} \tag{18}$$

$$\beta_{\Pi,j,sepa} = \frac{\Pi_{0,stay} - \Pi_{0,j,sepa}}{\overline{\Pi}}. \tag{19}$$

It holds that

$$\beta_{\Pi,j,sepa} \approx \beta_{(Y/L),j,sepa} - \beta_{(W/L),j,sepa}$$

The intercept α indicates the growth rate in the reference group of the stayers and the coefficients of the included $STAYSH_j$ variables (M–1 age group variables) indicate differences in the growth rate in the reference age group and in the groups j.[3]

When using the above equations for estimation, there are possible sources of bias. First, there is unobservable firm heterogeneity both in productivity and wage levels, which is correlated with the firms' choice of labor input. In particular, new firms often start with new work force which only slowly evolves over time (Haltiwanger, Lane, & Spletzer, 1999). Therefore, firm (or plant) vintage and worker cohorts tend to be tied together, with young workers being employed in firms that have new equipment and a high productivity level. Since we are using growth rates as the dependent variables, this issue is not a great concern. Our approach is related to the use of long differences in fixed effects models (we define the growth rates and labor flows in two-year periods). We also control for some observable firm characteristics (included in Z).

Second, there is heterogeneity across workers. This would not be an issue if the firms would randomly choose new employees from the pool of applicants or would randomly pick up those who are laid off. This is not likely to be the case, however, since the firms may pick up the best applicants and poor performers. Our hiring and separation flows may therefore be unrepresentative of the corresponding age groups in the whole population. However, the selection bias should affect productivity growth and wage growth in the same way (see Hellerstein & Neumark, 2004) and therefore be eliminated when we examine their difference, i.e. productivity-wage gaps which directly relate to firm performance.

Third, the hiring and separation rates are based on the firms' decisions and therefore most likely correlated with the error terms. For example, productivity shocks may lead to the hiring of new, young workers, which then causes an overestimate of their productivity effect (cf. Olley & Pakes, 1996; Levinsohn & Petrin, 2003). We address this issue by using instrumental variables that take into account exogenous variations in the supply of

labor in the local labor market and the structure of the work force in the firms that is "inherited" from previous periods.

3. Empirical analysis

The data for this study is drawn from the *Finnish Linked Employer–Employee Data* (FLEED) publicly available for research purposes (subject to terms and conditions of confidentiality) at *Statistics Finland*'s research laboratory. FLEED merges comprehensive taxation and other administrative records of all labor force members as well as all employers/enterprises (including information also on their establishments) subject to value added tax (VAT). It can be complemented by a range of additional information from both private and public sources. FLEED currently covers the years 1990–2002 with near-perfect traceability of employers and employees across time. The business register, educational statistics, employment statistics, financial statement statistics, manufacturing census as well as various surveys are among the original sources of FLEED variables.

To define the labor flows and changes in productivity, wage, and profitability, we use 2-year windows. The flows and changes are defined for the 4 periods 1995-97, 1997-99, 1999-2001, and 2001-2003.[4] The observation unit is a firm. In principle we also have data on establishments, but information on value added, our preferred measure of output, and some other relevant variables (like capital intensity) about establishments are lacking beyond the manufacturing sector. Further, the links between employees and firms are more reliable than those between employees and establishments, especially in multi-unit firms.

The dependent variables are defined as follows. Labor productivity growth is measured as a two-year rate of change in value added per employee, average wage is correspondingly a two-year rate of change in wage sum per employee, and change in profitability is a two-year relative change in value added per labor costs (wages and social security payments).

The labor flows are based on the comparisons of employees in the firms in two time periods, *t* and *t-2*. The flow rates are calculated separately for three age groups, "young" (- 30 years), "middle-aged" (31-50 years), and "old" (51 - years). We use fairly broad age group to ensure that we have enough employees in the groups when hiring and separation are disaggregated by age. In each period the age is based on the situation at the end year. For example, those who were 28 years old in *t-2*, are 30 years old in *t* and hence included among the "young". Those who were 30 already in year *t-2*, are 32 in *t*, and hence included in the middle group. The age group classification is thus based on year *t* age, and not on the age at which the employees were last observed in the firm.

The hiring rate HR_{jit} for age group *j* is the number of new employees in firm *i* in the age group (those in the firm in *t*, but not in *t-2*) divided by the number of all employees of the firm in *t*. The separation rate SR_{jit} is the number of exited employees of firm *i* in age group *j* (those in the firm in *t-2*, but no longer in *t*), divided by the number of all employees in the firm in *t-2*. The share of stayers, $STAYSH_{jit}$, is the number of staying employees of firm *i* in group *j* (those in the firm both in *t* and *t-2*), divided by all stayers of the firm in *t-2*. The sum of these stayer shares is therefore one, so one of the groups is left out of the estimation.

As controls we use the change in log of capital per employee, the initial levels (in *t-2*) of log of value added per worker and log of average wage, and a set of dummy variables. The dummies include interacted industry and period dummies (54 industries) to account for the effects of idiosyncratic industry shocks, and likewise a set of dummies as controls for the possible regional effects (20 regions).

Since the labor flows may be endogenous, we have constructed a number of instrumental variables for them. Hiring of new employees can be instrumented with variables that account for exogenous regional shifts in labor supply in the three age groups. Our first instrument is the number of individuals who have graduated from institutions of secondary or higher level education per working age population in the area (or areas) where the firm is situated during the years *t-2* and *t-3*. The area is defined as the

municipality where the firm is located and all adjoining municipalities.[5] For the firms that operate in many areas, we have used a weighted average of the areas in question. The other instruments for hiring are the separation rates of employees in the three age groups in the area where the firm is located. The regional separation rates in the business sector are calculated by using establishment level data. The regional separation rates between periods *t-4* and *t-2* are used as the instruments for hiring of firms operating in the area in periods *t-2* and *t*. All of these instruments describe exogenous shifts in the availability of new employees of different ages.

As instruments for separation we used the hiring rates of the three age groups in the area where the firm operates. These were calculated in the same way as the separation rates. The regional hiring rates by age groups between periods *t-4* and *t-2* are used as instruments for separations in firms operating in the area in periods *t-2* and *t*. These variables describe demand shifts in the local labor market that may lead to job-to-job switches. As a robustness check we estimated the model by dropping the shares of the continuing employee age group shares and used them instead as additional instruments. They describe the potential out of which the separations happen. In addition, we used the shares of homeowners among each firm's employees in the age groups as instruments for separation. One can argue that home ownership creates adjustment costs for job switching and therefore should work as an instrument for the separation rates.

Before conducting the econometric analysis we have removed some potentially erroneous observations that may potentially distort our results. First we have removed those observations where the number of linked employees differs more than 10% from the number of employees in company data. This indicates the linking of the individual and firm data is incomplete. Finally, we have removed some potentially influential outliers that we detected by using the method proposed by Hadi. The method is useful for detecting of multiple outliers in multivariate data. Identification of outliers was made on the basis of three variables: 1) the growth rate of average monthly earning calculated from the data on individuals in the Employment Statistics, 2) the growth rate of average wage calculated from the company data, and 3) the productivity growth rate. The first

two variables should be highly correlated with each other because they essentially are gauging the same thing, but may sometimes differ due to possible inaccuracies in the links between employees and their employers, for instance. Wage growth is usually correlated with productivity growth, but sometimes they may be very different because of measurement errors in output and/or labor input. Identified outliers (457 out of 20 096 firm-period observations) were removed in all estimations except in median regression estimation (see Appendix A3).

Table 1 gives some descriptive summary statistics of our basic sample that is used in the regression analysis below. The basic data set includes 19 639 observations. The average number of linked employees per company is 83.4, which is close to the average number of employees in these firms according to company data (84.0 employees measured in full-time equivalents). In other words, our regressions are based on 1.65 million individual-period observations. Because we have four periods, our sample covers about 410 000 individuals per period (those individual that are employed at least either in the initial or end year by a company in our sample). This is roughly one third of the total employment in the non-farm business sector.[6]

The average nominal productivity growth rate in the 2-year periods is 4.1%. Average wage growth rate, calculated from company data, is 6.7%. This is reasonably close to the average growth of monthly earnings of the linked employees (6.9%) obtained from the register data on individuals (Employment Statistics). The average level of monthly earnings is €2130. The average hiring rate is 28.7% (the sum of the hiring rates of the three age groups) and the average separation rate is 24.5% (the sum of the separation rates of the three age groups).[7] Young employees account for 17% of the continuing employees (i.e. those who have been employed in the same company in periods *t* and *t-2*), and the old workers account for 21%.

Variable	N	Average	p1	Median	p99
Average employment (CD)	19639	84.0	11.0	25.5	1010.0
Average employment (ES)	19639	83.4	10.5	25.0	1009.5
Labour productivity growth rate	19639	0.041	-0.733	0.044	0.774
Wage growth rate (CD)	19639	0.067	-0.437	0.067	0.561
Wage growth rate (ES)	19639	0.069	-0.188	0.068	0.328
Profitability growth rate	19639	-0.025	-0.716	-0.021	0.633
Monthly earnings (ES), in euros	19639	2130	1108	2021	4289
Hiring of -30 years	19639	0.143	0.000	0.117	0.545
Hiring of 31-50 years	19639	0.123	0.000	0.100	0.450
Hiring of 51- years	19639	0.021	0.000	0.000	0.167
Separation of -28 years	19639	0.085	0.000	0.057	0.483
Separation of -28 years, unemp.	19636	0.010	0.000	0.000	0.105
Separation of -28 years, other	19636	0.075	0.000	0.050	0.444
Separation of 29-48 years	19639	0.118	0.000	0.083	0.563
Separation of 29-48 years, unemp.	19636	0.022	0.000	0.000	0.200
Separation of 29-48 years, other	19636	0.096	0.000	0.069	0.474
Separation of 49- years	19639	0.042	0.000	0.023	0.267
Separation of 49- y., retirement	19639	0.012	0.000	0.000	0.111
Separation of 49- y., unemp	19639	0.014	0.000	0.000	0.154
Separation of 49- y., other	19639	0.015	0.000	0.000	0.154
Share of staying -30 years	19639	0.170	0.000	0.133	0.684
Share of staying 31-50 years	19639	0.619	0.188	0.625	1.000
Share of staying 51- years	19639	0.211	0.000	0.200	0.600
Share of home own. among -30 y.	16549	0.575	0.143	0.511	1.000
Share of home own. among 31-50 y.	19550	0.717	0.250	0.739	1.000
Share of home own. among 51- y.	17391	0.848	0.333	0.886	1.000

Note: CD and ES refer to Company Data and Employment Statistics information, respectively.

Table 1. Descriptive statistics of estimation sample.

Table 2 reports the basic estimates. We have restricted the sample to firms that employ at least 10 employees and left out the firms with over 10 000 employees (8 observations were dropped from the sample due to the size exceeding 10 000 employees). All of the estimation results reported below are based on weighted estimation, with firm employment used as the weight. The entries in the third column are from a separate estimation, but they are roughly equal to the difference of the entries in the first two columns. The results show that hiring of young employees lowers the productivity level of the firm, presumably because of lack of general skills of the newly hired young workers. However, they also have lower wages, so that the profitability effect is close to zero. Hiring mid-aged does not have an effect on productivity, but a positive wage effect. The net effect on profitability is thus negative. The hired old workers have considerably

lower wage level than the average worker in the firm in year *t* and therefore these recruitments are not a burden to the firm.

In the separation side, exiting young employees impact both productivity and wage negatively. One interpretation of this result is that it is the best performers who have already gained some experience in the firm who are leaving. Our point estimates suggest that young leavers are underpaid but, because of a relatively large standard error, the profitability effect does not differ from zero in a statistically significant way. However, when the profitability gap of young leavers is compared to that of the older leavers, the difference of 23.4% (16.7%+6.7%) is significant economically and statistically. Separation of the older employees has a fairly high positive productivity effect and a smaller wage effect. These estimates indicate that the separating older employees have a lower productivity level than the continuing employees, but they are also on average paid less. The net effect is an increase in profitability. This result seems to support the deferred pay argument. In the Finnish pension system the work-related pension has been based on the last years' income level in each employment relationship.[8] Therefore, also the institutional setting has encouraged bargaining for wage profiles that give a high pay at the end of the career.

As a robustness check of our results we estimated the basic model (Table 2) with the largest firms (over 1000 employees) left out of estimation. The results are reported in Appendix table A1. We obtain further evidence that separation of older workers increases the productivity level of the firm and to a lesser extent the wage level. The point estimate of profit effect is positive but it is no longer statistically significant.

	Productivity	Wage	Profit
Change in log of K/L	0.026***	0.028***	-0.001
	(0.009)	(0.004)	(0.007)
Initial log of prod. level	-0.176***	0.030***	-0.207***
	(0.016)	(0.005)	(0.016)
Initial log of wage level	0.057**	-0.239***	0.296***
	(0.024)	(0.013)	(0.020)
Hired -30 years	-0.135***	-0.158***	0.022
	(0.045)	(0.022)	(0.039)
Hired 31-50 years	-0.020	0.042**	-0.063*
	(0.043)	(0.021)	(0.037)
Hired 51- years	-0.103	-0.165***	0.057
	(0.162)	(0.062)	(0.137)
Separated -28 years	-0.148***	-0.079***	-0.067
	(0.056)	(0.028)	(0.062)
Separated 29-48 years	-0.033	0.012	-0.046*
	(0.025)	(0.008)	(0.028)
Separated 49- years	0.228***	0.063***	0.167*
	(0.080)	(0.022)	(0.085)
Continuing 31-50 years	-0.005	-0.001	-0.006
	(0.043)	(0.016)	(0.040)
Continuing 51- years	-0.070	-0.070***	-0.003
	(0.045)	(0.020)	(0.040)
Observations	19636	19636	19636
R-squared	0.245	0.218	0.270

* p<0.1, ** p<0.05, *** p<0.01
Note: Firms with at least 10 and at most 10 000 employees included. Employment weighted.
All models include region dummies and interactions of industry and period dummies.

Table 2: Estimation results for the basic model

The separations of the oldest age group may be driven by very different influences. Some of these employees are retiring. Some are laid off and may face periods of unemployment. Some are still looking for new jobs and quit to move to another firm. Finally, some withdraw from the labor market. To investigate whether there are significant impacts of different types of separations on firm performance, we have disaggregated the separation rate of the age group over 50 to three flow rates: separation rate to pension (old age pension or disability pension), unemployment (including unemployment pension), and other (job-to-job moves and withdrawal from the labor market). For the sake of comparison, we have divided separations of the other age groups by destination into unemployment and other. (There are very few in these age groups that

end up into retirement; they have been included in the category “other”.) The estimation results with this disaggregation are shown in Table 3.

Now the outflow of older workers into retirement and unemployment (e.g. unemployment pension) is found to have a statistically and economically significant positive impact on a firm’s productivity indicating that these worker groups had lower than the average productivity level before they left. The results for wages (the second column) show that the wage level of these workers did not differ significantly from the average level. In other words, our results indicate that these worker groups had been paid more than their productivity and their separations have been thus profitable to firms, which also can be seen in the positive coefficients of the third column (profitability equation). The productivity-wage gap is quite substantial, about 30%. On the other hand, the results of Table 3 reveal that those older workers that have left the firm for some other destination (e.g. employment in another firm) had not been overpaid. These workers account for roughly one third of the total separations of the older workers. So, a substantial proportion of the older workers are not found to be overpaid in our analysis. Interestingly, we do not find statistical evidence that those young or middle aged workers that have separated into unemployment would have been overpaid.

	Productivity	Wage	Profit
Change in log of K/L	0.027***	0.028***	-0.001
	(0.009)	(0.004)	(0.007)
Initial log of prod. level	-0.174***	0.029***	-0.204***
	(0.016)	(0.005)	(0.016)
Initial log of wage level	0.056**	-0.241***	0.297***
	(0.024)	(0.013)	(0.020)
Hired -30 years	-0.133***	-0.168***	0.033
	(0.045)	(0.022)	(0.039)
Hired 31-50 years	-0.015	0.044**	-0.060
	(0.042)	(0.021)	(0.037)
Hired 51- years	-0.093	-0.162***	0.064
	(0.162)	(0.062)	(0.138)
Sep. -28 y., unemp.	-0.245	-0.420***	0.165
	(0.200)	(0.106)	(0.166)
Sep. -28 y., other	-0.134**	-0.041*	-0.089
	(0.064)	(0.025)	(0.070)
Sep. 29-48 y., unemp.	-0.073	-0.114**	0.044
	(0.116)	(0.048)	(0.096)
Sep. 29-48 y., other	-0.010	0.019**	-0.030
	(0.028)	(0.009)	(0.032)
Sep. 49- years, pension	0.364**	0.092	0.273*
	(0.173)	(0.067)	(0.163)
Sep. 49- years, unemp.	0.424***	0.099	0.330***
	(0.133)	(0.061)	(0.114)
Sep. 49- years, other	0.115	0.031	0.083
	(0.095)	(0.029)	(0.114)
Continuing 31-50 years	-0.009	-0.001	-0.009
	(0.043)	(0.016)	(0.040)
Continuing 51- years	-0.079*	-0.076***	-0.007
	(0.045)	(0.019)	(0.040)
Observations	19636	19636	19636
R-squared	0.246	0.220	0.272

* p<0.1, ** p<0.05, *** p<0.01
Note: Firms with at least 10 and at most 10 000 employees included. Employment weighted.
All models include region dummies and interactions of industry and period dummies.

Table 3: Estimation results with separation of age groups disaggregated by destination

Our interpretation is that especially the outflows to unemployment reflect the firm's choices whereas especially the route to old-age pension is a more exogenous event to the firm. It is worth noting that the Finnish pension and unemployment insurance systems have a peculiar exit route called "unemployment pension pipeline", which allows unemployed to withdraw from the labor market at a relatively early stage (until 1996 at age 53) by successively transferring to unemployment compensation, unemployment

pension and finally to normal pension.[9] It has actually been relatively common for the firms to use this system for downsizing their labor force. It can also be argued that it has in many cases been in the mutual interest of the firms and the employees (Hakola & Uusitalo, 2005). Our results are quite consistent with the existence of this policy that makes it easy for firms to concentrate labor shedding to the older employees.

As a robustness check of the results with disaggregated separation rates we re-estimated the model with the smallest firms (below 50 employees) left out to ensure that there are enough employees in the disaggregated flows. The results are reported in Appendix Table A2. We also estimated the model of Table 2 using median regression (Appendix Table A3). Our main conclusions remain intact.

In the analysis above the fixed firm effects were eliminated by using two-year differences. However, our main findings would be biased if, for instance, the separation of older workers is a consequence of a profitability shock to the firm. So, due to the potential endogeneity of the hiring and separation flows we have estimated the models using the instrumental variables discussed above. Since the shares of the stayers can be considered as more exogenous than the hiring and separation rates, we have not instrumented them. We concentrate on the equation for change in profitability. The instrumental variables estimates are reported in Table 4. In the first column we include period dummies, in the second column we drop the dummies, and in the third column we also drop the variables for stayers and use them as instruments instead. In the third column we also include the share of homeowners as an instrument.

In the first column none of the flow variables obtain significant coefficients. When we drop the period dummies, the separations of the oldest employees has a positive profitability effect. Finally, when we use the stayer shares and home ownership variables as exogenous instruments, the separation rate of the oldest gains even more significance. Hence, although the instrumental variables estimation render most of the flow variables insignificant, our strongest result in the OLS estimations still gets support. However, we now find evidence that also the hiring of older workers is unprofitable for the firm.

	Profit	Profit	Profit
Initial log of prod. level	-0.246***	-0.275***	-0.300***
	(0.031)	(0.054)	(0.044)
Initial log of wage level	0.358***	0.333***	0.345***
	(0.078)	(0.081)	(0.090)
Hired -30 years	1.010	0.756	0.149
	(1.850)	(0.969)	(0.605)
Hired 31-50 years	-1.404	0.271	0.207
	(2.189)	(0.749)	(0.667)
Hired 51- years	3.312	-3.815	-6.481***
	(6.016)	(4.789)	(2.309)
Separated -28 years	-0.261	-0.596	-0.067
	(0.905)	(0.908)	(0.742)
Separated 29-48 years	-0.397	-0.658	-0.642*
	(0.736)	(0.426)	(0.382)
Separated 49- years	1.543	2.894**	2.033**
	(2.162)	(1.297)	(0.965)
Continuing 31-50 years	0.342	0.055	
	(0.655)	(0.281)	
Continuing 51- years	-0.026	-0.106	
	(0.567)	(0.299)	
R-squared	-0.077	-0.344	-0.504
Observations	19470	19470	17172
Overident. test (a)	0.654	0.549	0.979
Relevance test (b)	0.025	0.002	0.000

* p<0.1, ** p<0.05, *** p<0.01
Note: Firms with at least 10 and at most 10 000 employees included. Employment weighted.
All models include region dummies and industry dummies

Table 4: Instrumental variables estimates of the basic model for profit equation

4. Conclusions

We have proposed a new way of estimating the performance effects of age using flows of labor to and from firms. The results support the argument that at the end of the working career wage exceeds productivity. This may be a reflection of deferred compensation. There are also differences between separations of the oldest employees to various destinations. It should be noted that our estimates gauge the total effects of outflows of the oldest workers on productivity. Besides a direct productivity effect (i.e. a worker's efficiency in her own task), the estimates of this kind of analysis may arguably also capture various indirect effects that come into being through the diffusion of knowledge between different worker groups within a firm. Important as the diffusion of the tacit

knowledge of older worker to the employer may be in many circumstances, our results, however, suggest that generally this effect does not outweigh possible shortages in productivity.

While the results are consistent with the idea of deferred compensation, the institutional setting has obviously also contributed to the results by creating incentives for firms to downsize by laying off the oldest employees. On the other hand, the pension system has given incentives for wage profiles that peak at the end of the career. Our results support the view that firms have followed the incentives created by the system for improving their performance. In future work we intend to examine in more detail how changes in the firms' incentives have affected the labor flows and thereby profitability.

There are increasing pressures for keeping the aging labor force at work. In a recent pension reform in Finland, the subjective right of the employees to stay at work longer has been extended to 68 years. On the other hand, the firms' possibilities for using the "unemployment pension pipeline" for laying off older workers has been limited, as the starting age of the pipeline has been increased. There is also reduced availability of labor because of smaller age cohorts. These developments create pressures for firms for keeping their older employees and for using new means for improving their performance, like changes in work organization and rotation of tasks. At the same time, the way pension levels are calculated has been changed. In the future it is the earnings over the whole working career rather than in the last few years that counts. It remains to be seen how these developments affect the wage profiles. The old system has included high payments at the end of the career and a fixed retirement age (consistently with Lazear, 1979, although the system has been based on a mix of centralized negotiations between labor unions, employer organizations and the government, and firm-level wage setting). The new system with longer, less fixed retirement age, and fewer incentives for bargaining a back-loaded wage might give rise to flatter wage profiles.

Appendix

	Productivity	Wage	Profit
Change in log of K/L	0.043***	0.029***	0.014***
	(0.006)	(0.004)	(0.005)
Initial log of prod. level	-0.192***	0.028***	-0.222***
	(0.014)	(0.004)	(0.014)
Initial log of wage level	0.025	-0.269***	0.295***
	(0.025)	(0.013)	(0.020)
Hired -30 years	-0.155***	-0.147***	-0.010
	(0.037)	(0.021)	(0.032)
Hired 31-50 years	-0.052	0.042**	-0.094***
	(0.037)	(0.019)	(0.031)
Hired 51- years	-0.223*	-0.145**	-0.080
	(0.132)	(0.061)	(0.114)
Separated -28 years	-0.099**	-0.097***	-0.000
	(0.045)	(0.030)	(0.060)
Separated 29-48 years	-0.029	0.019**	-0.049*
	(0.022)	(0.008)	(0.025)
Separated 49- years	0.153**	0.052**	0.102
	(0.073)	(0.021)	(0.080)
Continuing 31-50 years	0.026	0.024	0.001
	(0.028)	(0.015)	(0.026)
Continuing 51- years	-0.057*	-0.037**	-0.023
	(0.034)	(0.017)	(0.032)
Observations	19434	19434	19434
R-squared	0.175	0.208	0.180

* p<0.1, ** p<0.05, *** p<0.01

Note: All models include region dummies and interactions of industry and period dummies.

Table A1: Estimates of the basic model for firms with 10-1000 employees

	Productivity	Wage	Profit
Change in log of K/L	0.017	0.028***	-0.010
	(0.013)	(0.006)	(0.010)
Initial log of prod. level	-0.165***	0.023***	-0.188***
	(0.022)	(0.007)	(0.021)
Initial log of wage level	0.097***	-0.198***	0.295***
	(0.034)	(0.017)	(0.029)
Hired -30 years	-0.169*	-0.248***	0.078
	(0.087)	(0.040)	(0.075)
Hired 31-50 years	0.011	0.111***	-0.100
	(0.091)	(0.043)	(0.083)
Hired 51- years	-0.122	-0.316**	0.185
	(0.331)	(0.128)	(0.286)
Sep. -28 y., unemp.	-0.447	-0.830***	0.358
	(0.481)	(0.253)	(0.390)
Sep. -28 y., other	-0.127	0.029	-0.151
	(0.091)	(0.027)	(0.093)
Sep. 29-48 y., unemp.	0.030	-0.116	0.160
	(0.295)	(0.117)	(0.238)
Sep. 29-48 y., other	-0.020	0.010	-0.031
	(0.037)	(0.011)	(0.041)
Sep. 49- years, pension	0.854**	0.393***	0.468
	(0.400)	(0.146)	(0.377)
Sep. 49- years, unemp.	0.676***	0.178*	0.504***
	(0.225)	(0.101)	(0.190)
Sep. 49- years, other	0.118	0.002	0.114
	(0.123)	(0.036)	(0.146)
Continuing 31-50 years	-0.040	-0.046	0.003
	(0.097)	(0.032)	(0.092)
Continuing 51- years	-0.120	-0.140***	0.016
	(0.093)	(0.036)	(0.084)
Observations	5121	5121	5121
R-squared	0.310	0.281	0.329

* p<0.1, ** p<0.05, *** p<0.01

All models include region dummies and interactions of industry and period dummies

* p<0.1, ** p<0.05, *** p<0.01

Table A2: Estimates for firms with over 50 employees and at most 10 000, with separation of oldest age group disaggregated by destination

	Productivity	Wage	Profit
Change in log of K/L	0.049***	0.021***	0.022***
	(0.003)	(0.001)	(0.002)
Initial log of prod. level	-0.212***	0.032***	-0.268***
	(0.005)	(0.003)	(0.004)
Initial log of wage level	-0.083***	-0.353***	0.336***
	(0.009)	(0.004)	(0.006)
Hired -30 years	-0.106***	-0.093***	0.001
	(0.020)	(0.010)	(0.014)
Hired 31-50 years	0.005	0.033***	-0.057***
	(0.020)	(0.010)	(0.014)
Hired 51- years	-0.210***	-0.058**	-0.047
	(0.053)	(0.026)	(0.037)
Separated -28 years			0.025*
			(0.014)
Separated 29-48 years			-0.034***
			(0.010)
Sep. 49- years, pension	-0.049	-0.095**	0.040
	(0.077)	(0.037)	(0.053)
Sep. 49- years, unemp.	0.049	-0.001	0.074*
	(0.058)	(0.028)	(0.039)
Sep. 49- years, other	0.046	0.009	0.011
	(0.043)	(0.022)	(0.031)
Continuing 31-50 years	0.040**	0.057***	-0.013
	(0.016)	(0.008)	(0.011)
Continuing 51- years	-0.000	0.017*	-0.030**
	(0.019)	(0.009)	(0.013)
Observations	20095	20093	20076
R-squared			

* p<0.1, ** p<0.05, *** p<0.01

Firms with at least 10 and at most 10 000 employees included
All models include region dummies and interactions of industry and period dummies

Table A3: Median regression estimates with separation of oldest age group disaggregated by destination

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[1] See "Ericsson puts age limit on redundancy" (Financial Times, April 25, 2006), "Revieving and revising Wal-mart's benefits strategy", Supplemental Benefits Documentation, Bord of Directors retreat FY06 (http://www.nytimes.com/packages/pdf/business/26walmart.pdf). Some observers, however, argue that Wal-Mart is not as low labor cost firm as generally thought, since turnover costs are high ("Wal-Mart's real cost of labor", San Diego Union-Tribune, July 7, 2004).

[2] There is empirical research in management, and to some extent in labor economics, where it is investigated whether it is the good or poor performers who have a higher propensity to quit. This work explicitly addresses the issue of heterogeneity in the labor flows, but requires that there are data available on individual productivity. In contrast to this, we intend to estimate the relative productivities of various components of labor turnover.

[3] Maliranta (1997), Vainiomäki (1999), Maliranta and Ilmakunnas (2005), as well as Diewert and Fox (2005) have presented similar decompositions.

[4] We leave out the period 1990-1994, because it was a period of a deep recession and may not be representative of the developments of labor flows and firm performance. In addition, our company data is substantially less comprehensive before the year 1995.

[5] More precisely, the numbers for each area are calculated by taking a weighted average of all municipalities in the area around the "central municipality". Each municipality is the "central municipality" of its labour force area. So, calculations are performed separately for each municipality so that the number of areas is equal to the number of municipalities in Finland. The weight of an adjoining municipality is the share of employees of the total number employees in the "central municipality" who have their residence in that adjoining municipality. The weight of the "central municipality" is the share of those employees in the "central municipality" that do not commute between municipalities.

[6] The number of observations drops because we have not included some industries, like finance and real estate, where definition of output is difficult. Further, the smallest firms (below 10 employees) have been excluded, as well as those where the linking of individuals and firms has not been successful, and some outliers.

[7] Note that these figures underestimate actual turnover among the employees, since e.g. hiring of an employee after the start of a two-year period and subsequent separation of the same employee before the end of the period is not included in the turnover rates.

[8] Up to 1996 the pension was based on the last four years' pay in each employment relationship, and until 2004 on the last ten year's pay. From 2005 pensions are based on annual incomes and are no longer tied to employment relationships.

[9] Up to year 1996 it was possible for those who became unemployed at the age of 53 to be for two years on normal earnings-related unemployment compensation, then for five years on a special extension of unemployment compensation, and at the age of 60 they could retire to unemployment pension until they finally reached normal retirement age. From 1997 the starting year of the pipeline was raised to 55 years. From 2005 the system has been changed so that the starting age of the pipeline is 57 and unemployment pension is no longer available for the younger cohorts.